

Common Cause Failure Modeling

Abstract

Common Cause Failures (CCFs) are a known and documented phenomenon that defeats system redundancy. CCFS are a set of dependent type of failures that can be caused by: system environments; manufacturing; transportation; storage; maintenance; and assembly, as examples. Since there are many factors that contribute to CCFs, the effects can be reduced, but they are difficult to eliminate entirely. Furthermore, failure databases sometimes fail to differentiate between independent and CCF (dependent) failure and data is limited, especially for launch vehicles. The Probabilistic Risk Assessment (PRA) of NASA's Safety and Mission Assurance Directorate at Marshall Space Flight Center (MSFC) is using generic data from the Nuclear Regulatory Commission's database of common cause failures at nuclear power plants to estimate CCF due to the lack of a more appropriate data source. There remains uncertainty in the actual magnitude of the common cause risk estimates for different systems at this stage of the design. Given the limited data about launch vehicle CCF and that launch vehicles are a highly redundant system by design, it is important to make design decisions to account for a range of values for independent and CCFs.

When investigating the design of the one-out-of-two component redundant system for launch vehicles, a response surface was constructed to represent the impact of the independent failure rate versus a common cause beta factor effect on a system's failure probability. This presentation will define a CCF and review estimation calculations. It gives a summary of reduction methodologies and a review of examples of historical CCFs. Finally, it presents the response surface and discusses the results of the different CCFs on the reliability of a one-out-of-two system.

Topic: Common Cause Failure

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